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# AWRI Commercial Closure trial – Twelve Month Report Performance testing of ACI Nanocork closure



#### **BACKGROUND**

The Australian Wine Research Institute (AWRI) is an internationally renowned research organisation in the fields of wine chemistry, manufacturing operations and packaging technologies. AWRI's research into closure technologies has built its reputation as an expert in and independent assessor of different wine closures in bottled wine (Godden *et al.*, 2001; Godden, 2001; Godden 2002; Godden *et al.*, 2005).

This commercial closure trial is designed to provide suppliers of closures with a means of evaluating their products relative to various reference products using criteria identified through research outcomes (Godden *et al.*, 2001; Godden, 2001; Godden 2002; Godden *et al.*, 2005) and extensive consultation with wine industry specialists. Previous AWRI closure trials have demonstrated that the protocol used is scientifically sound and have confirmed that the monitoring of optical density at 420 nm, free and total sulfur dioxide as well as the sensory characteristics of wine provided a means of evaluating relative closure performance over a period of time.

These results summarised in this report can be used as evidence of performance relative to the reference closures, but not with any endorsement of the AWRI implied.

#### **PROTOCOL**



#### The closures

The participating companies were asked to provide a minimum of 800 closures to the AWRI, from which 300 closures were selected randomly from the hopper during each bottling run at VinPac, Angaston. A hold back sample was taken of the remaining closures in case later testing was required.

Three reference closures used in this study include: - a screwcap, - a synthetic closure and - a natural cork. The screw caps used were a standard Stelvin saran tin liner screw cap produced by Alcan. The synthetic closures used were SupremeCorq X2 (length 45 mm), and the reference two natural cork (length 44 mm) were from a QC checked batch sourced from the stock from a major winery.

#### The bottles

All bottles were new, and were purchased from O-I Glass, Adelaide, through VinPac International. The bottles used for the cylindrical closures were 'flint'-coloured 'claret' bottles (manufacturer's code 5372). For the screwcap closures, a similar 'flint'-coloured' bottle with a BVS screw thread was used.

## The wine

The wine chosen was a 2007 Semillon purchased from Constellation Wines Australia's, Leasingham Winery, located in the Clare Valley, South Australia. The winemakers at Leasingham were requested to produce a wine of similar characteristics as previously used in AWRI closure trials (unoaked, around 11 % alcohol, relatively neutral with some fresh citrus, tropical notes, taint and fault free) and to use normal commercial practice in the making of the wine including in the clarification and fining of the wine.

The bottling

Bottlling operations were performed on May 16<sup>th</sup> 2007, at VinPac International Pty Ltd, Angaston, South Australia, a large ISO 17025-certified contract bottling facility. VinPac's routine quality control procedures were performed on all equipment prior to bottling. The wine was filtered through a 0.45µm filter and bottled at a temperature of 17-19°C.

Closures were applied according to the supplier's specifications, or in the absence of specifications, in accordance with good manufacturing practise based on VinPac's experience with the closure type. All participants had the option of exclusively observing the bottling of their closures.

300 bottles of wine were bottled for each closure, with each bottle labelled with consecutive numbers and the closure type. Random bottles taken from the bottling line were tested for dissolved oxygen and dissolved carbon dioxide using an Orbisphere instrument.

#### **STORAGE**

The 300 bottles (for each closure) were randomised at packaging so a random sample containing 12 bottles could be selected without opening multiple cartons. The labelled bottles were immediately packed into cardboard cartons and sealed. Cartons were stacked on pallets. The cartons remained upright for 24-36 hours after which they were inverted and then transported to the Hickinbotham Roseworthy Wine Science Laboratory cellar adjacent to the AWRI. Here they are stored inverted in the wine storage area on pallets with approximately 64 cartons to the pallet. The temperature in the storage facility is maintained at approximately 17°C and 55 % humidity.

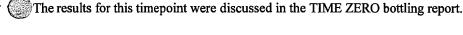
#### PRE-BOTTLING ANALYSES

Tank samples of the finished wine were submitted to the AWRI Analytical Service for pre-bottling analyses including alcohol, organic acids, free sulfur dioxide (free SO<sub>2</sub>), total sulfur dioxide (total SO<sub>2</sub>), glucose+fructose, volatile acidity (VA), specific gravity (SG), titratable acidity (TA), pH, pinking, ascorbic acid, dissolved carbon dioxide, laccase activity, optical density at 420 nm (OD 420nm), and metals (copper, iron, potassium, sodium), as well as chloranisoles and agrochemical residues. The results for these analyses were presented in the initial report.

A preliminary sensory evaluation was also performed by expert AWRI wine tasters to ensure the wine was suitable for the closure study. The wine was described as a pleasant, fairly full bodied and flavourful Semillon with the following sensory attributes: clean with no faults, fairly neutral, with some estery and tropical fruit notes, quite acid on the palate.

#### POST BOTTLING TESTING (TIME ZERO)

Initial testing was performed on 12 randomly selected bottles within 48 hours of bottling by the AWRI Analytical Service. The tests involved were alcohol, pH, TA, VA, free SO<sub>2</sub>, total SO<sub>2</sub> and OD 420nm.



SIX MONTH TESTING

After six months storage, 12 bottles of each closure were removed from storage and analysed for chemical constituents, for sensory properties and for physical parameters, including extraction force and ease of re-insertion into the bottleneck.

Chemical analysis performed included free SO<sub>2</sub>, total SO<sub>2</sub> and OD 420 nm. The same samples were used for the sensory evaluation which was a descriptive analysis by a trained panel. All analyses were performed in the week of 12 - 16 of November 2007. The results for this timepoint were discussed in the previous report.

#### TWELVE MONTH TESTING

After twelve months storage, 12 bottles of each closure were removed from storage and assessed for chemical constituents and sensory properties.

Chemical analysis performed included free SO<sub>2</sub>, total SO<sub>2</sub> and OD420 nm. The same samples were used for the sensory evaluation which was a descriptive analysis by a trained panel. All analyses were performed in the week of 19 - 23 of May, 2008. The results and number of replicates for each test are presented in Appendices 1 and 2.

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#### **EXPERIMENTAL**

#### Methods of chemical analysis

All analysis was performed by the AWRI, Analytical Service, a NATA accredited (ISO 17025 certified) wine laboratory.

Free and total sulfur dioxide was measured using Flow Injection Analysis (FIA, Lachat). Optical density was determined by measurement of the absorbance at 420 nm on a Varian UV/visible spectrophotometer.

All analyses were performed by trained staff and were performed in conjunction with NATA accredited quality assurance measures including standards, blanks, duplicates and control samples. The quality control measures were required to meet established criteria before acceptance of the analytical data.

#### Method of sensory evaluation

A panel of nine judges, comprising AWRI staff with extensive experience in wine sensory evaluation, of whom all but one had participated at the previous testing time was used for this study. An initial discussion session was held on 19 May, 2008, with the tasters assessing six of the wines from the current study. These wines were selected based on a preliminary evaluation by the project sensory team to identify those samples displaying the largest sensory differences, and included the reference screwcap and synthetic closures. The tasters assessed the wines in silence, followed by a discussion regarding the sample's characteristics, to decide upon the attributes that would be rated in the subsequent formal sessions. The attribute list was slightly modified from that applied at the earlier testing time. A list of the terms that was agreed upon by the panellists is given in Table 1.

An initial practice rating session was held, with the tasters assessing a sample of each of the wines from the current study under the same conditions as the formal sessions but with a constant presentation order. Following the practice session panel performance was assessed and all panellists were considered to be performing adequately.

For the formal sessions, samples were assessed by the judges independently in blind tasting conditions using standardised procedures. Fifteen wines were assessed in a session, incorporating one example of each closure and the three reference closures. The samples were assessed in one set of eight and one set of seven, with a forced rest between sets of at least five minutes. Four bottles of each closure type were assessed over four sessions over three days, the 21 May, 22 May and 23 May. The samples (30 mL) were presented to tasters in 3-digit coded, covered XL5 (ISO standard) glasses, in a random presentation order across judges. The tasters were instructed to assess each wine for aroma and then palate, and then move to the next sample. The tests were carried out in the AWRI's sensory facility in isolated, temperature controlled, ventilated tasting booths under sodium colour masking lights, with temperature control between 22-24°C. Data was acquired using Fizz 2.30B software (Biosystemes, Couternon, France).

The panellists scored each attribute on a structured line scale of 0-9; where 1 corresponded to just detectable, 5 to a moderate intensity and 9 to a very strong intensity. Tasters were also given the opportunity to rate any other attributes evident in any sample. Data analysis was carried out using GenStat Release 10.1 (VS.N International). Analysis of variance was carried out testing for the effect of closure type and bottle replicate nested within closure type followed by a Fishers Least Significant Difference mean comparison test (P=0.05).

Table 1. Sensory attributes scored.

Attribute	Definition/synonyms
Aroma	
Estery	Confectionary, banana lolly
Floral	- · · · · · · · · · · · · · · · · · · ·
Fresh Citrus	Lemon, lime, zest
Cooked Citrus	Cooked lime, brown lime cordial
Tropical fruit	Includes pineapple
Overall fruit	Overall fruit aroma
Honey	Honey, caramel
Toasty	Toasty, nutty
Oxidised	Aldehyde, bruised apple, cardboard, wet dog, lanolin
Plastic	Fresh PVC
Glue/solvent	'Clag' glue, model aeroplane glue
TCA	TCA, musty, mouldy
Struck flint	Struck match, reductive, toward burnt rubber
Cabbagey	Rotten egg, cabbage, sewerage
Palate	
Acidity	Perceived acidity
Overall fruit	Overall fruit flavour on palate
Persistence	Fruit flavour persistence
Plastic	Plastic flavour
Glue/solvent	Clag glue, Model aeroplane glue
Other	Any other aroma or flavour attribute

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#### **RESULTS**

Twelve month chemical analysis results compared to time zero data are reported in APPENDIX 1, Table 1. Twelve month sensory evaluation results are reported in APPENDIX 2.

#### **CHEMICAL TESTING RESULTS**

#### Chemical analysis

The following outlines results at 12 months for free & total SO<sub>2</sub> concentrations and OD 420nm. Trends associated with closure properties are only just starting to evolve from subtle variations in these parameters associated with bottling practices. A more detailed discussion of trends related to closure performance will be provided at 18 months after obtaining a fourth data point.

Free SO<sub>2</sub> concentrations over the 12 month trial period are shown in Figure 1. From the 12 month data it is apparent that:

- The reference screwcap has retained significantly more free SO<sub>2</sub> than the reference 2 natural cork, the reference synthetic cork and the Nanocork, and
- there were no significant differences in free SO<sub>2</sub> between the Nanocork, reference 2 natural cork and reference synthetic closures.

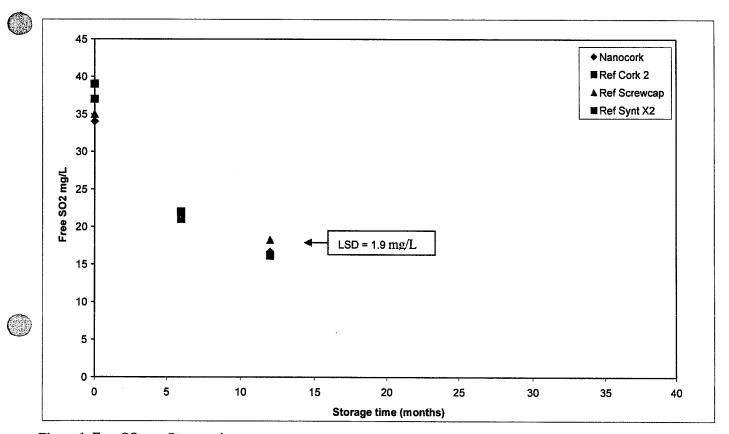


Figure 1. Free SO<sub>2</sub> vs. Storage time.

For total SO<sub>2</sub> results (Figure 2), the reference screwcap was found to retain slightly more (but statistically significant) SO<sub>2</sub> than the reference synthetic closure, but a similar level in SO<sub>2</sub> concentration to the Nanocork closure.

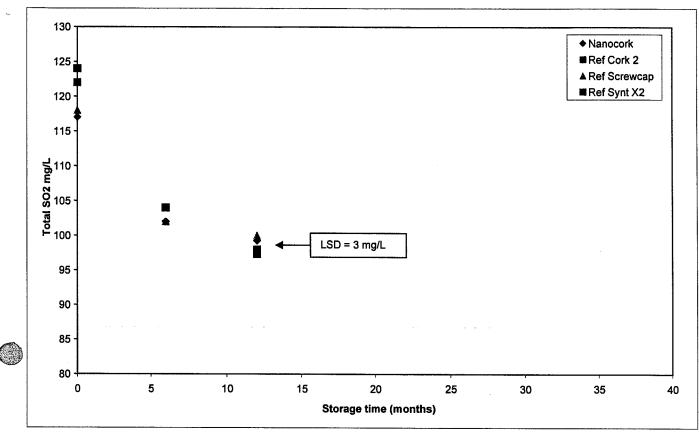


Figure 2. Total SO<sub>2</sub> vs. Storage time.

OD 420nm values show a trend emerging, with the Nanocork clustering closely with the reference 2 natural cork, with OD 420nm values above the reference synthetic and reference screwcap closures (Figure 3).

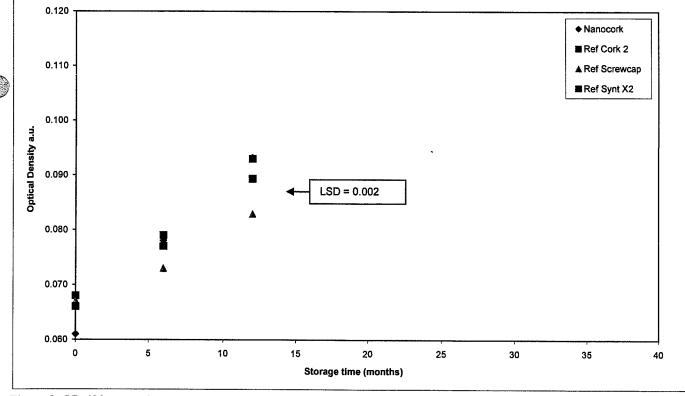


Figure 3. OD 420nm vs. Storage time.

#### SENSORY TESTING RESULTS

### Sensory evaluation by descriptive analysis

From the analysis of variance of the sensory data, it was found that there were significant differences among the closures studied for all attributes, except 'glue/solvent' (aroma and palate) 'plastic aroma' and 'toasty'. There were no significant differences among the replicates for any of the closures except for the attribute 'honey', which was variable across bottle replicates for several of the closures studied (Appendix 2). This finding is elaborated upon further in the discussion.

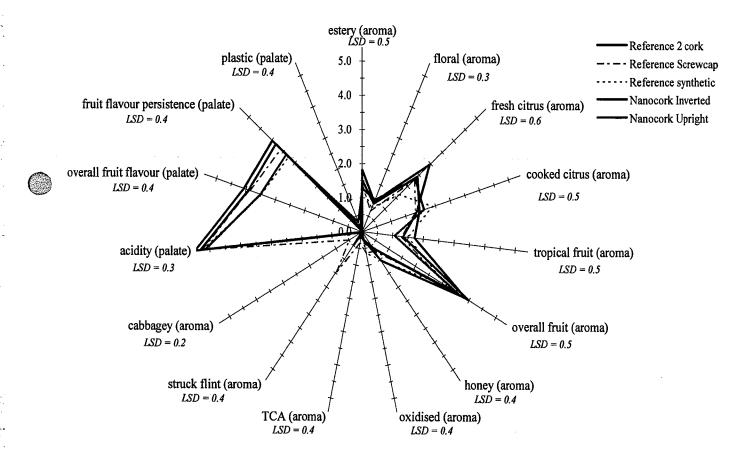


Figure 4. Spider diagram showing closure sensory attributes at the 12 month time point.

Significant differences between the closures for sensory attributes scoring ≥1\* are summarised below in Table 2. \* Note. Sensory attributes scoring <1 are considered to be minor/less important components of the wine flavour and aroma. Differences were deemed significant when the difference between two mean values was greater than the LSD value (Figure 4).

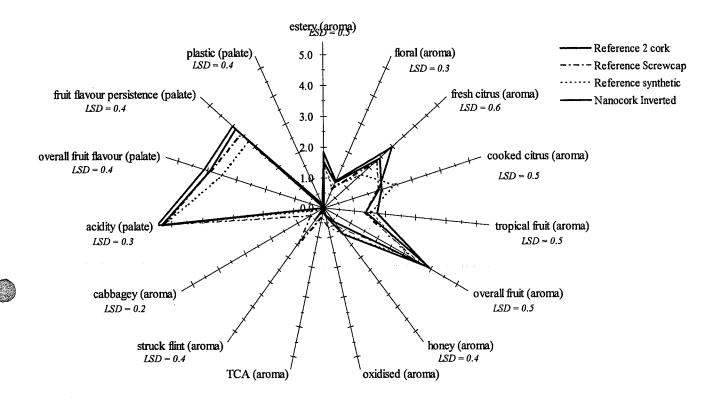


Figure 5. Spider diagram showing sensory attributes for the Inverted Nanocok at the 12 month time point.

Significant differences between the closures for sensory attributes scoring ≥1\* are summarised below in Table 2. \* Note. Sensory attributes scoring <1 are considered to be minor/less important components of the wine flavour and aroma. Differences were deemed significant when the difference between two mean values was greater than the LSD value (Figure 5).

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Table 2. Significa	nt sensory	difference	s for senso	ry attribu	tes scoring	g ≥ 1 durir	ig sensory	assessmen	<u>t</u>	
	estery (aroma)	floral (aroma)	fresh citrus (aroma)	cooked citrus (aroma)	tropical fruit (aroma)	overall fruit (aroma)	honey (aroma)	struck flint (aroma)	overall fruit flavour (palate)	fruit flavour persistence (palate)
Reference 2 cork (ref 2)			> syn < Ninv		> Nup	> sc > syn	> Ninv > Nup	< sc	> syn > Nup	> syn > Nup
Reference screwcap (sc)		< Nup <ninv< td=""><td>&gt; syn &lt; Ninv</td><td>&lt; syn</td><td></td><td>&lt; ref 2 &lt; Ninv</td><td></td><td>&gt; ref 2 &gt; syn &gt; Ninv &gt; Nup</td><td>&gt; syn &gt; Nup</td><td>&gt; syn &lt; Ninv</td></ninv<>	> syn < Ninv	< syn		< ref 2 < Ninv		> ref 2 > syn > Ninv > Nup	> syn > Nup	> syn < Ninv
Reference synthetic (syn)	< Ninv	7.70	< ref 2 < sc < Ninv < Nup	> sc > Ninv		< ref 2 < Ninv	> Ninv > Nup	< sc	<ref 2="" <="" ninv<="" syn="" td=""><td>&lt; ref 2 &lt; sc &lt; Ninv</td></ref>	< ref 2 < sc < Ninv
Nanocork Inverted (Ninv)	> syn > Nup	> sc	> ref 2 > sc > syn > Nup	< syn		> sc > syn	< ref 2 < syn	< sc	> syn > Nup	> sc > syn > Nup

# **DISCUSSION**

Nanocork

Upright (Nup)

The following emerging trends are noteworthy of discussion:

> sc

> syn

< Ninv

< Ninv

1) The reference screwcap is displaying higher free SO<sub>2</sub> concentrations and a lower OD 420 nm value than the other reference and upright Nanocork closures. Reductive characters (struck flint and cabbagey) were also higher for the screwcap closure than the Nanocork closure (upright and inverted) and reference 2 natural and synthetic reference corks. These findings imply that the screwcap has had a lower net oxygen ingress than these closures.

< ref 2

< ref 2

< syn

< sc

< ref 2

< Ninv

< sc

< ref 2

< Ninv

- 2) Upright and inverted storage of wines bottled under Nanocorks appears to be producing sensorially-different wines. The inverted-wine (in direct contact with the closure) showed significantly higher estery and fresh citrus aromas and higher levels of overall fruit flavour and fruit flavour persistence than the upright-wine (headspace above the closure). Inverted storage of the wine under a Nanocork therefore, appears to be producing a wine consistent with lower oxygen ingress.
- 3) Sensory assessment of the reference screwcap closures identified differences amongst replicates in the honey, as well as several other attributes, which are consistent with varied oxygen ingress. This could be a symptom of either bottling variations or variable closure performance. The cause of this variation will be clarified further during future assessments of the wine at the 18 and 24 month timepoints.

# **CONCLUSION**

Results of the 12 month timepoint in the closure trial revealed the emergence of trends in free SO<sub>2</sub>, total SO<sub>2</sub>, OD 420nm, and in wine sensory characteristics, suggesting closure type is beginning to significantly impact the development of the wine. Only 3 data points have been collected, therefore, it should be emphasised that these are emerging trends only which should become more apparent with assessment of subsequent timepoints. Considering this, however, the following conclusions can be made:

- 1) The reference screwcap is displaying higher free SO<sub>2</sub> concentrations and a lower OD 420 nm value than the other reference and upright Nanocork closures, implying that it has had a lower net oxygen ingress than these closures.
- 2) Inverted storage of the wine under a Nanocork appears to have produced a wine consistent with lower oxygen ingress, as evidenced by more fresh fruit and esters as attributes.
- 3) Reduced aromas (cabbage and struck flint) were not evident in either the upright or inverted Nanocork wines.

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Note: While we have every confidence in these results, factors such the manufacturing variations between batches have not been evaluated. This trial relates only to one style of wine and clearly winemakers should carefully test the shelf life of their product and the characteristics of their style of wine they wish to use.

Please note: This report may not be copied except in full. This report may be used in business to business communication to support the facts reported herein but not in the promotion of a product.

The Australian Wine Research Institute in no way endorses the product tested.

**Dr. Simon Odell**Project Manager
Analytical Service

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Attachments:

APPENDIX 1 Twelve month testing, Chemical data APPENDIX 2 Twelve month testing, Sensory evaluation

#### References:

Godden P.W., Francis I.L., Field J., Gishen M., Coulter A. D., Valente P., Hoj P.B. and Robinson E. (2001). Wine bottle closures: physical characteristics and effect on composition and sensory properties of a Semillon wine. Performance up to 20 months post-bottling. Australian Journal of Grape and Wine Research, 7: 64-105.

Godden, P.W. (2001) Update on the AWRI trial of the technical performance of various types of wine bottle closure: Analysis of the concentration of sulfur dioxide at 21 and 24 months post bottling. Tech.Rev. 133:1-3.

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Godden P., Lattey K., Francis L., Gishen M., Cowey G., Holdstock M., Robinson E., Waters E., Skouroumounis G., Sefton M., Capone D., Kwiatkowski M., Field J., Coulter A., D'Costa N. and Bramley B. (2005). Towards offering wine to consumer in optimal condition – the wine, the closures and other packaging variables: a review of AWRI research examining the changes that occur in wine after bottling. The AWRI report, Wine Industry Journal, vol. 20 no. 4, Jul-Aug.

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# APPENDIX 1: Twelve month testing - Chemical data

Table 1. Summary of twelve months testing. Chemical testing on Reference and Nanocork closures

	PROPERTY AND PROPERTY OF THE P	A STATE OF THE PROPERTY OF THE PARTY OF THE				ocork closu
Closure	Initial	Initial	Initial	12	12	12
				months	months	months
Reference						
Screwcap (Saran tin/Alcan)	Free SO <sub>2</sub>	Total SO <sub>2</sub>	OD <sub>420</sub>	Free SO <sub>2</sub>	T-4-100	OD
(Saran thir near)	mg/L	The trace of the less are the first	Charles and the second of the	Barrota salahan da	Total SO <sub>2</sub>	OD <sub>420</sub>
N	500000000000000000000000000000000000000	mg/L	a.u.	mg/L	mg/L	a.u.
Mean	35	118	0.067	18	100	0.083
Std Error	0.21	0.50	0.001	0.85	1.2	0.001
N	12	12	12	12	12.	12
	16					and the second
Reference 2 Natural Cork	Free SO <sub>2</sub>	Total SO <sub>2</sub>	OD <sub>420</sub>	Free SO <sub>2</sub>	Total SO₂	OD <sub>420</sub>
		10.000	OD420	1100 007	10001502	OD420
	mg/L	mg/L	a.u.#	mg/L	mg/L	a.u.
Mean	37	122	0.068	16	98	0.093
Std Error	0.13	0.58	0.000	0.68	0.80	0,002
N	12	12	12	11	11	11
						e e
Reference						
Synthetic	F 50	т 100				
(Supremecorq X2)	Free SO <sub>2</sub>	Total SO₂	OD <sub>420</sub>	Free SO <sub>2</sub>	Total SO <sub>2</sub>	OD <sub>420</sub>
	mg/L:	mg/L:	a.u.	mg/L	mg/E	a.u.,
Mean	39	124	0.066	16	97	0.089
Std Error	0.15	0.58	0.000	0.66	0.80	0.003
N	12	12	12	12	12	Salahara Barana
	12	12	120	14	14	12
ACI Nano	Free SO <sub>2</sub>	Total SO <sub>2</sub>	OD <sub>420</sub>	Free SO <sub>2</sub>	Total SO <sub>2</sub>	OD <sub>420</sub>
	mg/L	mg/L	a.u.	mg/L	mg/L	a.u.
Mean	34	117	0.061	17	99	0.093
Std Error	0.18	0.63	0.000	0.71	1.4	0.002
N	12	12	12	12	12	12
				14	14	14

APPENDIX 2: Twelve month testing – Sensory evaluation

Closure	Rep	Estery (aroma)	Floral (aroma)	Fresh citrus (aroma)	Cooked citrus (aroma)	Tropical fruit (aroma)	Overall fruit (aroma)	Honey (aroma)	Toasty (aroma)	Oxidised (aroma)	Plastic (aroma)	Glue/ solvent (aroma)	TCA (aroma)	Struck flint (aroma)	Cabbagey (aroma)	Acidity (palate)	Fruit flavour (palate)	Fruit flavour persistence (palate)	Plastic (palate) s
	LSD	0.5	0.3	0.6	0.5	0.5	0.5	0.4		0.4	<u></u>		0.4	0.4	0.2	0.3	0.4	0.4	0.4
Reference 2 cork	1	1.0	1.2	2.1	2.5	2.0	3.9	1.3	0.6	0.4	0.0	0.3	0.0	0.3	0.0	5.2	3.9	3.9	0.0
	2	1.5	0.8	2.0	1.5	1.3	3.3	1.3	0.1	0.5	0.6	0.0	0.6	0.2	0.0	5.1	3.5	3.3	0.5
	3	1.9	1.0	2.8	2.1	2.1	4.4	1.2	1.0	0.2	0.0	0.0	0.0	0.2	0.0	5.4	4.2	4.1	0.0
	4	1.6	0.7	2.8	1.8	1.4	3.9	0.4	0.5	0.0	0.4	0.2	0.1	0.5	0.0	5.4	4.1	4.0	0.0
	Mean	1.5	0.9	2.4	2.0	1.7	3.9	1.0	0.5	0.3	0.2	0.1	0.2	0.3	0.0	5.3	3.9	3.8	0.1
	Std. dev.	0.4	0.2	0.5	0.4	0.4	0.4	0.5	0.3	0.2	0.3	0.2	0.3	0.1	0.0	0.2	0.3	0.3	0.2
Screwcap	1	2.0	0.9	2.6	1.8	1.4	3.7	0.6	0.4	0.2	0.2	0.3	0.3	1.4	0.4	5.1	4.0	3.8	0.0
	2	1.7	0.6	2.9	1.4	1.5	3.5	0.4	0.6	0.7	0.4	0.0	0.5	1.2	0.7	5.5	4.2	3.9	0.0
	3	1.3	0.7	2.9	1.8	1.5	3.4	0.2	0.7	0.3	0.5	0.0	0.6	1.8	0.7	5.2	4.1	3.9	0.0
	4	0.5	0.5	0.8	2.2	0.8	2.8	1.6	1.2	1.3	0.6	0.3	0.0	1.4	0.1	5.2	3.3	2.8	0.0
	Mean	1.4	0.7	2.3	1.8	1.3	3.3	0.7	0.7	0.6	0.4	0.2	0.4	1.4	0.5	5.2	3.9	3.6	0.0
	Std. dev.	0.7	0.2	1.0	0.3	0.3	0.4	0.6	0.3	0.5	0.2	0.2	0.3	0.2	0.3	0.2	0.4	0.5	0.0
Reference synthetic	1	1.3	1.0	1.9	2.6	1.8	3.3	0.8	1.1	0.6	0.1	0.1	0.0	0.5	0.0	5.0	3.7	3.4	0.0
	2	1.3	0.8	1.6	2.0	1.2	3.2	1.2	0.8	0.6	0.0	0.1	0.4	0.0	0.0	5.5	3.5	3.1	0.0
	3	1.0	0.7	1.6	2.5	1.7	3.1	1.4	1.2	0.8	0.3	0.2	0.0	0.0	0.0	5.1	3.5	3.5	0.0
	4	1.4	0.6	1.5	2.6	1.2	3.3	0.8	0.1	0.5	0.6	0.6	0.0	0.1	0.2	5.3	3.3	3.0	0.3
	Mean	1.3	0.8	1.6	2.4	1.5	3.2	1.0	0.8	0.6	0.3	0.2	0.1	0.2	0.1	5.2	3.5	3.2	0.1
	Std. dev.	0.2	0.2	0.2	0.3	0.3	0.1	0.3	0.5	0.2	0.3	0.3	0.2	0.3	0.1	0.2	0.2	0.2	0.1

Closure	Rep	Estery (aroma)	Floral (aroma)	Fresh citrus (aroma)	Cooked citrus (aroma)	Tropical fruit (aroma)	Overall fruit (aroma)	Honey (aroma)	Toasty (aroma)	Oxidised (aroma)	Plastic (aroma)	Glue/ solvent (aroma)	TCA (aroma)	Struck flint (aroma)	Cabbagey (aroma)	Acidity (palate)	Fruit flavour (palate)	Fruit flavour persistence (palate)	Plastic (palate)	Glue/ solvent (palate)
	LSD	0.5	0.3	0.6	0.5	0.5	0.5	0.4		0.4			0.4	0.4	0.2	0.3	0.4	0.4	0.4	
Nanocork	1	2.2	1.3	2.4	1.7	1.4	3.6	0.4	0.2	0.3	0.3	0.0	0.1	0.5	0.0	5.3	3.9	3.7	0.0	0.0
Inverted	2	2.0	1.0	3.7	2.0	1.6	4.6	0.3	0.7	0.0	0.1	0.5	0.0	0.6	0.0	5.5	4.4	4.3	0.0	0.2
	3	1.6	0.6	2.9	1.8	1.2	4.1	0.7	0.3	0.2	0.1	0.3	0.0	0.3	0.0	5.6	4.4	4.4	0.0	0.4
	4	1.5	0.9	2.9	1.9	1.2	3.6	0.9	0.8	0.5	0.0	0.2	0.1	0.4	0.0	5.5	3.7	3.5	0.0	0.1
	Mean	1.8	1.0	3.0	1.9	1.3	4.0	0.6	0.5	0.2	0.1	0.3	0.1	0.5	0.0	5.5	4.1	4.0	0.0	0.2
	Std. dev.	0.3	0.3	0.5	0.1	0.2	0.4	0.3	0.3	0.2	0.1	0.2	0.1	0.2	0.0	0.1	0.4	0.4	0.0	0.1
Nanocork	1	0.8	1.3	2.0	2.5	1.1	3.5	0.5	0.8	0.1	0.1	0.0	0.0	0.4	0.0	5.2	3.4	3.6	0.0	0.0
Upright	2	1.3	1.2	2.6	2.0	1.1	3.6	0.7	0.5	0.5	0.6	0.0	0.1	0.3	0.0	5.1	3.8	3.5	0.3	0.0
	3	1.2	0.6	2.2	2.4	1.0	3.5	0.8	0.5	0.5	0.4	0.9	0.0	0.0	0.1	5.0	3.4	3.1	0.5	0.7
	4	1.8	1.0	2.6	1.6	1.1	3.8	0.4	0.2	0.2	0.4	0.0	0.0	0.4	0.0	5.3	3.5	3.2	0.5	0.0
	Mean	1.3	1.0	2.3	2.1	1.1	3.6	0.6	0.5	0.3	0.4	0.2	0.0	0.3	0.0	5.1	3,5	3.4	0.3	0.2
	Std. dev.	0.4	0.3	0.3	0.4	0.1	0.1	0.2	0.2	0.2	0.2	0.5	0.0	0.2	0.1	0.1	0.2	0.3	0.2	0.4